Rock Mechanics Applications for Geological Sequestration of CO_2

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One of the approaches to mitigation of climate change is to store (sequester) the carbon dioxide (CO_2) produced by large point source emitters (such as power plants) in deep geologic formations. Candidate formations are depleted oil and gas reservoirs, deep unmineable coal seams, and deep saline formations. The scale of such projects will be large; e.g. storage of the CO_2 produced by a 1,000 MW coal fired power plant for 30 years will require a 115 km^2 reservoir 100 m thick. Rock mechanics has some key roles to play in geologic sequestration. This paper discusses applications and provides example results in two areas. The first is in evaluating the potential and risk of leakage. Increased pore pressure due to CO_2 injection will result in stresses and displacements in the caprock. The potential for generating new fractures or displacements and concomitant increases in flow along existing fracture and faults needs to be evaluated. An example is given of the use of a coupled flow and geomechanical simulator to asses this potential for leakage along faults. In the model, CO_2 is injected into a sand layer that is laterally bounded by faults. Potential slip on the faults inside and outside the reservoir is calculated for different fault dips and properties. A second area of rock mechanics application is in monitoring the movement of CO_2 in the subsurface. Poroelastic effects of CO_2 injection will result in displacement of the ground surface. High-resolution synthetic aperture radar can now provide measurement of the magnitude of surface displacements and tilt meters can be used to measure the spatial gradient. An example is given of the use of this data to invert for the spatial distribution of pressure within the reservoir interval.